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To investigate the relationship of a creativity-oriented design curriculum to the creative development of gifted adolescents, an activities guide was developed and used with 27 pupils placed in a special art class which met for one period daily. Creativity tests were given and evaluations of art products were made before and after six months of the program for the experimental group and the 32 controls; although these frequently called for subjective judgements, criteria for rating were established. Students in the experimental group generally performed significantly better in tests of fluency, adaptive flexibility, and originality requiring divergent production, but not in convergent production or in rate of emission of familiar cognitive responses. Attitudes toward creativity changed in a positive direction, and experimental students indicated less fear of failure and more self confidence. Conclusions were that designing may be a more complex process than had been assumed and that an art program focusing on problem solving and creative behavior has important functions in the education of the gifted. (RJ)

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Creative Problem Solving Abilities In Art Of Academically Superior Adolescents

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PRIMARY QUESTION

The study of creativity by experimental psychologists in the last 15 years has focused mainly on the analysis of those behavioral traits which characterize creative people, and the relationship of these traits to intelligence and other personality variables. [1, 2, 3] Little attention has been paid to the kinds of experiences that might contribute to the development of these traits. Educators in art are involved with the latter problem: the development of creative potential. The broader question, explored in this study, was the relationship of a course of study including problem solving in design and the analysis of creative behavior, to the creative development of academically superior adolescents.

Hypothesis

Academically superior junior high school students who participate in this creativity-oriented design curriculum will show significantly greater increase in creative behavior than students who do not have this experience, as shown by two types of pre- and post-test measures: (1) standardized creativity tests, (2) personality measures that discriminate between more or less creative traits.

BACKGROUND OF THE STUDY

The formulation of the study was begun in 1958. The research on creativity at that time was in a stage of rapid development, but much of the current material was not then available. Some of the tests of J. P. Guilford and his associates were available and standardized to a point where they could be used. Some of the personality inventories and attitude scales appeared related to the creative abilities identified by Guilford.[4] The Guilford studies and Warner K. Schaie's[5] study of behavioral rigidity were the main sources used.

The underlying assumptions of the study were that:

(1) Creative behavior is a complex of abilities that most people have in varying degree, depending both upon their unique potential and upon their opportunities for developing it.

(2) Environment does play a role in the development of these

traits, but much needs to be known about the effectiveness of varied environmental treatments on different socio-ethnic-economic groups and people of differing creative aptitudes and opportunities.

It was decided to begin this research with a group study of the academically superior. The ninth grade was selected because it was the lowest academic grade in which it was feasible to use the standardized tests available.

Creative problem solving in design was used as the main training variable for several reasons. One, the arts have long been associated with "high creativity." An oft-repeated assumption in the folklore of the arts has been that participation in art develops creativity. Two, the arts are usually excluded from the high school training of the academically superior. If there is any validity in the first assumption it needs to be demonstrated, as the arts could be found to be a relatively untapped area for the development of the creative potential of superior students. Three, the study was motivated by a deep concern about the potential leadership of the country being deprived of the aesthetic awareness and perceptual skills necessary to help them develop the aesthetic quality of our civilization. Four, design rather than drawing and painting was selected for the course because it was believed that there was less resistance to the "designer" than the "artist" stereotype. Finally, the designing process appeared to be more easily analyzed so that tasks could be formulated that involved the kinds of abilities in studies of highly creative scientists, the subjects of most of the prior research.

During 1958-59 the proposal was prepared and a study made of the relationship of design to the organizational processes identified in Gestalt psychology[6] and the later work of Attneave.[7] During 1959-60 activities were formulated from the basis for a trial curriculum to be used with ninth graders. The experiment was conducted during 1960-61. During 1961-62 the tests were evaluated and subsequent time was spent in analysis of the data.

It was clearly recognized that this was an exploratory study carried out in a classroom rather than a laboratory situation, but a diligent effort was made to keep the research as controlled as possible.

METHODOLOGY

The Exploratory Year

Prior to and during the exploratory year three kinds of materials and activities were developed and used with a volunteer group of academically superior ninth graders. The curriculum materials included:

(1) The collection and condensation of pertinent psychological

materials on the creative process for the teacher's use in discussing creative ability and for the students' study. The selection and editing of biographical and autobiographical materials about creative people in the sciences and arts, for the students' use in identifying creative behavior.

(2) The utilization of resource persons in the community, men and women of evidenced creative leadership in the sciences and arts, to discuss their impressions of their own creative processes with the students. The purpose was to help students become more involved with creative people and to give them some possible models with whom to identify.

(3) Design activities were developed and tried by the students to find those more appropriate for tnis general age, ability, and interest level.

Development of Experimental Curriculum

No tested data emerged from this preliminary work, but the problems to be encountered in working with academically superior students who are faced with design problems where no single solution was "right" became more apparent. It seemed clear that these students were accustomed to specific assignments in which correct answers were expected. Too much freedom too soon seemed to cause confusion. For this reason many of the activities for the experimental year were designed so that assignments would have several areas of specificity but with some part or parts left open for tne student to solve. Only during the last part of the course was a great deal of self-direction required.

A final guide was developed for the experimental year. It was divided into four parts; the first unit introduced students to open-ended problem solving. Some practical activities were presented which attempted to stimulate students' initial involvement as they discovered their need for flexibility in solving problems in somewhat unique ways. For example, students were asked to attempt to achieve multiple goals with limited tools and materials. In other instances the goal, tools, and materials were limited but students could explore alternative uses of the materials to reach the goal, or again a specific goal was identified and multiple materials made available for reaching it.

The second unit explored the dynamics of perceptual organization--proximity, similarity, closure, and figure and ground--as they are related to the interaction of form, line, color, in design. Open-ended problems in design were assigned, using these principles of interaction.

The third unit was designed to increase student awareness of three-dimensional space, to help them overcome the limitations of conceptual reality (seeing things in terms of their knowledge and conceptual clas-

sification and to develop a greater flexible perception of changing spatial relationships, of the size and shape of form, and the value and intensity of color. Tasks were assigned in which the goal was the ability to creatively manipulate space.

The fourth unit, more open-ended, drew upon abilities it was hoped had been developed in the three prior units. The final task was student-selected, planned, and developed.

Another section in the guide was a supplementary source of help for the teacher. It consisted of specific materials from the research on creativity, which could be used for class discussion and student reading. The then current books on creativity were available to students. Further, 20 books of biography and autobiography of some of the men and women of recent times (whose creative brilliance in the sciences and arts is generally acknowledged) were available and reading assignments made in these. The students examined these last materials in order to identify the motivations and behaviors that appeared to lead these people to creativity.

The curriculum included the guide and its assignments, the readings, and lectures by resource persons throughout the four units. These people were selected for the excellence of their creative work. They included an internationally known mathematician, a contemporary woman painter, a leading physician, a philosopher-chemist, and an electronics engineer who had made major inventions.

The Experimental Situation

The tone of the class was somewhat academic; students kept notebooks of the teacher's and visitors' lectures and of their reading to use in stimulating their thinking for their own papers. This was done to make this class more like their other classes, reducing discontinuities by retaining as much of the familiar reward system as practical.

It should be noted that this study was made in a university community where pressure for academic achievement is considered to be very high. We were attempting to develop the creative behavior of these students during the first year in which their grades counted for college entrance; thus the pressure to conform to teacher standards to get good grades appeared to be very strong.

The teacher in this case was an excellent contemporary painter who was also trained as a social studies teacher. He was taking advanced graduate work in educational foundations as well as in art education and the study of creativity. He was warm and accepting toward students but dignified and reserved. To the research team he appeared to motivate students more through stimulating inquiry, activity, and study than through the force of his own personality. This reduced, in some

degree, the chances of the results being mainly the effect of the teacher's personality.

This class was organized like many other classes. It met the first period of every day, five days a week, and included a 20-minute homeroom period. This class was interrupted with fire drills, loud-speaker announcements, assemblies, and special occasions. No regular art classroom was available so a home economics room had to be used. The layout of the room imposed an artificial grouping of four students to an alcove. After each session meticulous cleanliness had to be restored. Limited storage space curtailed the uses of some materials. None of these factors contributed to what is generally considered an ideal open classroom situation, where freedom of movement and choice is to be encouraged. It was assumed, though, that the limitations of the physical environment were similar to other teaching situations, thus making the study related to typical classroom situations.

Since this was an additional class for these students, the research team had to agree that no outside study would be required. Time for use of resource materials had to be scheduled. However, students voluntarily did considerable work outside of class.

In addition, the teacher was injured and absent for four weeks. Most fortunately, a substitute teacher was available who had similar training and who worked closely with the staff to carry on the activity. The two teachers were both young men, dignified, and very intelligent. Thus we may say that, while every effort was made to control the situation, in most ways the variables were closer to those of a real classroom situation than to a laboratory study. Reason would lead us to believe that most of these variables would inhibit rather than contribute to the impact of a total teaching-learning experience.

Selection of Subjects

During the experimental years 34 ninth graders who had School and College Ability Test Scores of 90 and above in quantitative and verbal abilities were invited to participate in a "Creativity Class." Selection of students for the experimental group could not be made randomly because of parental attitude toward such a class and scheduling difficulties. Actual selection of those invited was as follows. (1) All the parents of students in this ability group in the school were invited to a meeting where the program was discussed. (2) All of the students whose parents agreed and whose schedules allowed entered the class. Among these students were some who wanted to take such a class, but many others were there because their parents thought it would be good for them. For this reason it was felt that a fair mixture of more or less motivated students was in the group.

The control group included students in the following categories:

(1) those who wanted to take the course but could not because of scheduling, (2) those whose parents were negativ about an "art" related course, and (3) those who did not wish to take it. To balance the possible motivation of taking a special course by the experimental group, students in the control group were sent a letter inviting them to participate in a testing program to be held at the university. They were told that they had been selected because they were outstanding students. From the larger pool of students a control group of 32 was selected that did not differ significantly in SCAT scores and academic achievement from the experimental group. Some subjects were lost in both groups due to absences. The final N was 27 for the experimentals and 32 for the controls.

The Research Design

The design of the experiment was a test-retest of an experimental and control group over a six-month period. The experimental group participated in the creativity class but otherwise had programs for the upper ability groups with the control group (See Table 1). It was assumed that enough forgetting would take place between two testing periods so that the same test forms could be repeated. The evaluation was in the differences in degree and direction of change between the two groups.

The testing situation differed for the two groups because it was impossible to take the control students out of their classes so identical time blocks could be used. The experimental group was tested in a sequence of regular class periods. The controls were taken to the university on a Saturday morning for the testing session. Within the time blocks the tests were administered according to the manual. These situations prevailed for both the pre- and post-tests.

Selection of Tests

There seems to be agreement that what is generally called "creativity" is a complex of behaviors which the general population shares in widely varying degrees. In a study such as this, it can only be assumed that some sampling of behaviors involved in creativity has been made and that the evaluation of changes in behavior in creativity is limited to the measuring instruments available. Personality traits as well as intellectual abilities are involved. In order to pursue the broader range of factors involved different types of tests were used.

J. P. Guilford was most generous in helping us select from his tests of creative behavior those that would be appropriate for ninth grade students and that would tap a broad range of abilities.

The Palo Alto Public Schools, in which this study was made, cooperated in the validation of the Myers-Briggs Type Indicator. This test

differentiates between personality types that are more or less creative.

The Schaie Test of Behavioral Rigidity was also available for research but in the process of development. This test, with the Allport-Vernon Study of Values results in ipsative scores which preclude comparison of group mean scores.

Table 2 gives the reliability correlations for most of the tests used. We were fortunate in that both the Guilford and the Myers-Briggs tests reliability was tested with similar age and ability groups. Reliability figures with comparable groups were not available for Guilford's Camouflaged Words, Hidden Figures and Gestalt Transformations which were part of his general battery at that time.

Evaluation of Tests

Several of the creativity tests and the art products involved subjective judgments. To attempt to minimize this effect the following procedures were used.

(1) Raters and checkers were trained with another battery of the same tests used on a different sample. If test manual criteria were not as specific as necessary these criteria were refined. Participants in the rating were also students of creativity research. Practice was maintained until at least 80 per cent agreement was achieved between rater and checker.

(2) All pre and post, control and experimental tests were folded to eliminate identification of S's. They were then shuffled and numbered. Using a table of random numbers 10 per cent of the tests were used to further train raters and checkers by identifying their agreements, analyzing their disagreements, and further refining the established categories when needed. These random tests were then put back in numerical order in the total test set. The practice scores were not used, but each test was rescored as it came up in the numerical sequence.

(3) The formal scoring procedure began with both the rater and checker scoring the first 10 per cent of the tests. If 80 per cent agreement was not achieved the differences were discussed and these tests' scores used. The rater alone scored the next 35 per cent of the tests. The next 10 per cent were checked by the checker and the same procedure followed. A check was made also of the last 10 per cent.

The purpose of this procedure was to insure that two other raters using the same criteria and equally trained in the field could get the same results. The system also is a check on the fatigue factor and helps to insure a consistency of judgments for the pre- and post-tests.

Evaluation of Art Products

A similar procedure took place with the art products. In this case no evaluative criteria were available that would work for the diverse kinds of activities that had been performed.

Two assistants, both doctoral students in art education with extensive art and art education and high school teaching experience, were the judges. They used student work done under the same curriculum at another school and spent many weeks clarifying the criteria by which they could agree in judgment. After the criteria were developed the exact meaning of each criteria was entered on the guide sheets. A score sheet was made with the final four criteria headings.

(1) Improvisation or Invention
(2) Asymmetry
(3) Integration
(4) Sensitivity

The student's use of texture, color, line, and form, in each of his products was then scored on each of these criteria and a total of these scores given. Thus each student received a total score on each product and a separate score for all his products on improvisation, asymmetry, integration, and sensitivity. The same procedure used for rating the creativity tests was used for the art works, but achieving 80 per cent agreement was much more difficult and not always attainable. Incidentally, this points to one of the great difficulties in using art products in research.

RESULTS

Correlations and Fisher's small group "t" test for correlated means were used to analyze the relationships and test the significance of differences between pre- and post-test scores on each of the measures used, for both the controls and experimentals.[12] In this way, in-group shifts could be analyzed. Finally the level of significance of any improvement of the experimentals over the controls was tested. In Guilford's study of his tests with high I.Q. ninth graders all the tests' frequency distributions were inspected and found to be appropriate for Pearson-r intercorrelations, except Consequences Remote and Plot Titles High (see Table 2). McNemar reports a study of Norton from which he indicates that even with skewness the F test at the .01 level gives a strong basis for accepting significance at the .02 level.[13] The .01 level was reached in both Consequences Remote and Plot Titles High so we conclude significantly greater change was made.

The Myers-Briggs frequency distributions are given with differing segments of the population. This selection prevents the distribution from being normal. Non-prep male high school students N=1483 and lib-

eral arts engineering freshmen N=4562 show different types of distribution on the indices. The two groups are most alike in distribution of EI and JP scores. Being all males the TF scores have higher T means. The SN scores are contrasted. The non-prep students are high in S, and the liberal arts and engineering students are high in N. Considering the relationships of N to higher I.Q. this distribution is not surprising. It also suggests that if the test were given to a broad sample of the general population instead of to biased samples that the curve might approach normalcy. In this study the Preference Scores were transformed into Continuous Scores.[14]

Since the Fisher's "t" test is very exacting and the levels of significance in most cases very high this procedure was felt to be adequate for analysis of these data.

Table 3 gives the details of the analysis of the experimental group; Table 4, the control group; and Table 5, the level of significance of the improvement of the experimental group over the control group.

Discussion

(1) Associational Fluency--a speed test in making meaningful relationships--a stimulus word is given and the task is to give as many associated words as possible. Both groups improved significantly, the control with a p value of .01 and the experimental of .001. The difference in degree of improvement of the experimentals over the controls was also p = .001.

(2) Expressional Fluency--the ability to make continuous discourse within a limited range of kinds of words. Both groups improved, the controls p = .02, experimentals p = .001, but the improvement of the experimentals over the controls was not significant.

(3) Ideational Fluency--the ability to evoke a large number of ideas within a certain range of concepts. We did not find significant improvement with either group, but in comparing the pre-test scores of our total group we found their mean scores considerably above the mean in Guilford's study of gifted ninth graders.[15] This leads us to believe that these students were already so high in this ability that the mean scores could not be changed.

(4) Word Fluency--requires that the subject produce as many words as possible within a letter class. In this case the control group did not improve significantly, but the experimental group did, and in comparison with the controls the p value of the difference was .001.

In the fluency category then we found two tests in which our experimentals improved significantly more than the controls. Guilford iden-

tifies the associational fluency test as most discriminating in identifying the DMR factor (divergent production of semantic relationships).[16] Word fluency is the most discriminating test of his battery in identifying the factor DSU (divergent production of semantic units).[17]

The second general trait of creativity we worked with was Adaptive Flexibility. Guilford found that his test Match Problems II was the most effective in identifying this ability.[18] A great deal of flexibility is needed to overcome the sets that are presented so that the problem can be solved. Both groups improved very significantly, but the experimental group's improvement was significantly greater than ($p = .001$) the control group's improvement.

In tests of originality, Guilford found the highest factor loadings with Plot Titles High and Alternate Uses.[19]

Plot Titles High

For this test the experimental group made a significant improvement ($p = .01$); the control group did not. In the difference between the changes in scores from the pre- to the post-test the experimentals made a significantly greater improvement with p value of .01 which, because of skewness, we can assume was significant at the .02 level.

In the Alternate Uses test our experimental group again improved significantly greater than the control group with a p value of .001. It is interesting to note that in some measure in each of the major areas of creative behavior that Guilford has identified, our experimental group improved significantly over the control group. In one other Guilford test we also had important results. Our experimental group improved at a greater rate at the $p = .01$ level in Consequences Remote, an originality test.

One of the important implications of these findings is that in the class, in which a large part of the activities involved manipulation of tools and materials, creation of visual symbols and organizations resulted in significant changes on conceptual tests of creativity. This would lead us to consider that some degree of transfer from one kind of activity to another may have taken place.

With the creativity measures we also gave personality inventories and one test of behavioral rigidity. Our findings with this are as follows:

The Myers-Briggs Type Indicator

We did not find significant differences in either shifts to or from introversion or extroversion.

In the second dimension of the test we did find an interesting shift. It concerns the use of sensation or intuition as the preferred or habitual mode of becoming aware. The individual who uses sensory (S) cues depends upon direct evidence. The one who relates and associates in the perceptual process is more intuitive (called the N dimension). We found a significant increase in N with the experimental group ($p = .05$) and it was very significantly higher ($p = .001$) in comparison to the control group. This indicates growth in more open use of perceptions, allowing visual awareness to become the means for seeing remote relationships, more possibilities from what is perceived, than just direct sensory information.[20]

In the third dimension, which concerns the use of feeling (F) or thinking (T), significant shifts were again found. We had a significantly greater increase in the use of feeling by the experimental group ($p = .001$). The dependence on reason appeared to be strong in most of these students in the pre-test situation. The control group during this same period went down in the use of feeling in the direction of significance ($p = .10$).

In the fourth dimension the effects of the perceptual training in the experimental class seem to be evidences. This dimension is an analysis of whether individuals become aware of something in its perceptual (P) qualities or just make a judgment about it.[21] When the P trait is combined with the use of intuition (N) a more creative response to experience can be expected. On the basis of these three parts of the Myers-Briggs test our experimental group tended in the direction of becoming more NFP.

MacKinnon's study of creative compared to less creative architects is interesting in terms of the students in our creativity class. MacKinnon says of creative architects that they require both s[illegible]ntific and artistic creativity.[22] We think there may be some parallel [illegible]th the experience of academically successful students going into a creative design class. Most of them had little or no prior art training. In a questionnaire in which they rated their preferences for classes, in sequence, those preferences were: reading, social studies, science, mathematics, and languages. Art was their sixth choice. If these students showed increased strengths in the personality dimensions of the most creative architects it lends credence to the possibility that the students' problem solving experience in design contributed to this development.

The most creative architects had much higher preference for the use of Perception than Judgment in the JP area of the Myers-Briggs test.[23] This was the one area in the Berkeley study of creative persons where the strong P preference was found. In other groups the proportion of J's to P's was about the same. The use of P more than J indicates an openness to perceptual experience, looking for possibilities and rela-

tionships rather than coming to a judgment which tends to stop the perceiving.

The second parallel we found between the creative architects and the students in our experimental group was in the intuitive, compared to the sensory response. Our students increased significantly in the N dimension. MacKinnon found this high use of intuition in all his creatives in all the fields he studied as well as among the architects.[24]

Myers reports that the N dimension is highly preferred by both male and female high creatives (97% men, 96% women).[25] Greatest preference for perceptual (P) responses is found among creative men and women, the National Merit finalists, and gifted junior high school students.[26]

The Schaie Test of Behavioral Rigidity

The Schaie TBR test also produced interesting results. The difficulty of evaluation and lack of standardization of the test in its form, as then used, limit somewhat the usefulness of the findings. In the Motor Cognitive rigidity score the controls became significantly ($p = .05$) more rigid; the experimentals increased in flexibility, but not significantly. It is interesting that the controls pre- and post-standard deviation changed little, 17.9 to 18.3, but the experimentals had a greater range of change suggesting that some of the students responded in this dimension quite differently after the experimental treatment. The experimental SD shifted from 12.8 to 21.8. The p value for the difference in change of the experimentals over the controls is .05, an acceptable level of significance. Schaie describes this factor as "the ability to shift without difficulty from one activity to another. It is a measure of effect adjustment to shifts in familiar patterns and to continuously changing demands."[27]

The "Personality-perceptual rigidity" score seeks to indicate the individual's ability to adjust readily to new surroundings and change in cognitive and environmental patterns."[28] Neither group changed significantly, nor was there any significant difference between them.

The "Psychomotor speed" score indicates the "individual's rate of emission of familiar cognitive responses."[29] In this instance the controls increased significantly ($p = .001$) while the experimentals decreased significantly at the .01 level. The controls' increase over the experimentals was at the .001 level of significance. Further the experimentals' SD decreased indicating more regression to the decreased mean. This particular result raises interesting questions about the treatment in relation to the use of familiar cognitive responses. Does increased creativity decrease effectiveness in using familiar material? Why?

This last finding on the Schaie test may have some relationship to

the findings on the Guilford tests. Our experimental group did not improve significantly better in three convergent production ability tests--Hidden Figures, Gestalt Transformations, and Camouflaged Words. In all these tests one has to operate convergently within a framework to solve the problem. But our experimentals did improve significantly in three divergent tests of transformation which means going outside the framework to solve the problems. These were Consequences Remote, Plot Titles High, and Match Problems. It may be that creative development in divergent or new situations was developed in the experimental curriculum rather than convergent reorganization, in familiar situations.

Content Analysis of Student Evaluations

At the end of our experimental year the students in the experimental group were asked to evaluate the program in a paper that would not be graded but that would be used by the project in evaluating what had taken place. A content analysis procedure was used to identify what was contained in the papers as a whole. This means that rather than reading the papers and getting an impression, a trained evaluator, not connected with the project or familiar with the students, read the papers for key concepts. A second rater read them, and the concepts were pooled and refined. Then each paper was read to see how many responded to the different concepts and in what directions. The ratings were checked nine weeks later to obtain a measure of temporal reliability which was 89.7%. The per cent agreement between the two raters was 87.8%. The students reported the following changes in their behavior and attitudes.

Attitudes Toward Creativity Seminar at Beginning and End of Year

Beginning:

None were positive at the beginning of the year.
Ten were negative.
Six reported lack of information.
Eleven made no comment.

End of Year:

General Attitude:

Twenty-six were positive.
One made no comment.

Flexibility:

Nineteen reported that they felt they were more flexible in the use of materials.

Reaction to people who are different:

Eighteen reported that they were much more positive in their reactions to non-conformists.
Seven reported that they already appreciated non-conformists.

Changes in attitude towards failure:

Nineteen reported that they had learned that failure was useful in creative work such as:

> "Before this course I would have been completely stumped by failure, but now I think of it as a help in achieving my best goals."

Five reported fear of failure that had been lessened or overcome:

> "My attitudes have changed considerably; I used to be scared to death to fail in anything."

> "My attitude towards failure has changed. Now I feel that if you have made an intelligent attempt but you still fail, it was worth it."

> "I have always been depressed by failure and still am; now I am more willing to try along different lines."

Increased interests:

Sixteen students reported increase and broadening of interests.

Difference in self-concept:

Eleven reported more self-confidence.
Eight reported they were less self-centered.

Correlations Between Design Products

In analyzing the correlations figures of each of the design activities with each of the other, and with separate scores on each of the evaluative criteria: Improvisation, Integration, Asymmetry, and Over-all Sensitivity, we found that the correlations between design tasks were extremely low and in many cases negatively correlated--if good in one, the students would be poor in another.

The design activities we used are in common practice. The one major difference between this course and others is that we relied more on an intellectual study of design than on an intuitive study as the former was the way these students were used to operating. In some of the assignments students analyzed and used the effects of the human perceiving organism to group things that are in close proximity, or that are similar in color, shape, size, or texture. They studied the effects of figure and ground in the organization of their designs. They explored how suggested forms would be continued or completed as the perceiver tends to make closure and complete what he sees.

The correlations we found were as follows: Low positive correlations of .3 to .4 were found between single activities and any one of the culminating activities. For example, the initial task of constructing a strong, attractive form of toothpicks and glue that would hold five pounds of books was related to the final over-all two-dimensional abstract design problem--but not to any other activity. Discovering and creating texture was related to a final project of redesigning a common household object to improve it aesthetically--but not to any other task.

Only two sets of tasks, where neither was a culminating task, were related. Using one applicator of ink to make many textures to see how many ways it can be used to make textures was correlated with designing pictures from colored ink blots at r = .36. Changing and modifying initials was correlated at .36 with using diagonal lines to make a cohesive design using the principles of proximity, similarity, and closure.

The strong negative correlations that were found were between separating figure and ground with the use of color and with both organizing diagonal lines at -.23 and redesigning a household object (a culminating activity) at -.29.

Students who were good at designing imaginary pictures from ink blots were poor in using the principle of similarity to create interesting designs at -.38 and redesigning a household object at -.31.

The correlations between the different criteria for evaluating the designs were as follows: improvisation and asymmetry, .32, improvisation and integration, .45, improvisation and sensitivity, .45, integration and sensitivity, .42, integration and asymmetry, .34. The one very low correlation was between over-all sensitivity and asymmetry which some in the field have assumed was very related to more creative behavior. This is a surprising and interesting finding, but one that needs much more study with a much higher N before we can come to any conclusions about it.

The study does lead us to hypothesize that designing may be a much more complex process than we had assumed, using many more kinds of abilities than we had realized, thus involving many more areas for individ-

ual differences. It would appear that our open-ended problem-solving type of approach to teaching does help a class as a whole. But we do have some evidence that this method is not as effective with the few more intuitive high ability students in the group.

SUMMARY

In summary we may say that we have made a global, exploratory study of the relationships between one, a specific kind of art training (a somewhat structured but increasingly open-ended approach to problem-solving in design) coupled with the study of creative behavior of people in the sciences and arts and exposure to creative individuals in these fields; and two, shifts in creative behavior as measurable by the Guilford Creativity Battery, the Myers-Briggs Type Indicator and the Schaie Test of Behavioral Rigidity. The relationship was studied by comparing two groups of students, both equally able in aptitude and performance as measured by the School and College Ability Tests (upper 10%) and school grades. The control group had the tests battery administered and readministered over a six-months time lapse. The experimental group had the same testing but had the art and creativity experience besides their usual program for students at this ability level.

It was found that the students in the experimental group, generally performed significantly better in the post-tests than the controls in tests of fluency, adaptive flexibility, and originality requiring divergent production, but not in convergent production, nor in rate of emission of familiar cognitive responses. We have some evidence that values, attitudes, and self-concepts can be changed towards more acceptance of failure as a tool for exploration, and the non-conformist as a valuable member of society. Further we have some evidence that the designing process may be much more complex than we had imagined.

Thus we may say that we do have support for our original hypothesis and that this particular type of training for students of this ability level and general socio-economic level is effective in changing their responses to these particular measures, of these segments, of the behaviors subsumed under the concept "creativity."

We do not know which of the dimensions of the curriculum were most effective, nor do we know if the same kinds of activities would be effective with other ability level or socio-economic groups. In a group study such as this we do not know if the treatment was effective for all students. A subsequent case study analysis may give more insight into this later question. Probably the most crucial question, which can be answered only as this topic is further studied and defined, is, did we tap the most important functions of creative behavior that can be handled within the context of public school education? The results though are strongly suggestive that an art program that focuses on problem

solving and creative behavior does have important functions in general education of the academically superior.

Further, the study was an exploration of curriculum development which could be tested for its effectiveness. The behaviors of artists (in this case, designers) was studied to develop content for the course in conjunction with the behaviors identified in creativity research. A trial run was made to refine the curriculum for a particular segment of the school population from a middle, upper-middle class society. A test retest study was made to see if the objectives for changed behavior were in any degree achieved.

Table (1) Diagrammatic Presentation of the Procedure Followed in the Experiment

Group	Pre-testing Sequence Nov. 1960	Major Variables	Post-testing Sequence July 1961
Experimental Group (N=27)	Guilford Creativity Fluency Ideational Associational Expressional Word Alternate Uses Plot Titles Consequences Match Problems II Gestalt Trans. Camouflaged Words Hidden Figures Myers-Briggs Type Indicator Allport Vernon* Schaie TBR	1) Open-ended problem solving in design. 2) Exposure to creative people. 3) Study of creativity and creative people. General School Program for Upper Ability Groups.	The test battery listed in the first column was repeated at this time.
Control Group (N=32)	As Above	General School Program for Upper Ability Groups.	

*to be used in case studies

Table (2) Test Reliability

	r_{tt}
Guilford Creativity[8] (Spearman-Brown extensions of alternate form correlations. N=209, Sample: 9th grade, 120 I. Q. and over)	
Associational Fluency	.63
Expressional Fluency	.67
Ideational Fluency	.69
Word Fluency	.78
Alternate Uses	.78
Consequences Remote*	.56
Consequences Obvious	.78
Plot Titles High **	.44
Plot Titles Low	.78
Match Problems II	.62
Myers-Briggs Type Indicator[9] (Split-half reliability correlations Spearman-Brown prophecy formula. N=100, Sample: National Merit Finalists--Males)	
Extroversion-Introversion	.85
Sensing-Intuition	.86
Thinking-Feeling	.82
Judgment-Perception	.89

*Normalized scores[10]
**Normalized scores on total I. Q. range, 9th graders, N=204[11]

Table (3) Experimental Group Pre and Post Test Results (N = 27)

	Pre M	Pre σ	Post M	Post σ	Mean Diff	SE Pre	SE Post	SE^2 Pre	SE^2 Post	pp	SE_D	SE_D	t	P level
Associational Fluency	14.63	4.22	19.96	4.79	+ 5.33	.81	.92	.66	.85	+.33	1.01	1.01	5.28	>.001
Expressional Fluency	8.41	2.81	10.44	3.53	+ 2.03	.54	.68	.29	.46	.58	.33	.57	3.56	>.001
Ideational Fluency	66.41	13.87	66.70	8.19	+ .30	2.67	1.58	7.13	2.50	.02	9.45	3.07	.97	NS
Word Fluency	35.63	11.60	47.56	9.44	+11.93	2.23	1.62	4.97	2.62	.56	3.55	1.88	6.34	>.001
Alternate Uses	23.04	6.59	32.78	6.21	+ 9.74	1.27	1.20	1.61	1.44	.56	1.35	1.16	8.40	>.001
Camouflaged Words	8.07	2.37	11.37	3.55	+ 3.30	.46	.68	.21	.46	.53	.34	.58	5.68	>.001
Consequences Remote	13.59	6.28	15.63	6.66	+ 2.04	1.21	1.28	1.46	1.64	.39	1.90	1.38	1.48	NS
Consequences Obvious	44.48	13.28	43.30	13.81	- 1.19	2.56	2.66	6.55	7.09	.48	7.09	2.66	.45	NS
Plot Titles High	1.26	1.32	2.22	1.28	+ .96	.25	.25	.06	.06	.26	.09	.31	3.11	>.01
Plot Titles Low	11.74	4.22	16.37	6.56	+ 4.63	.81	1.26	.66	1.59	.57	1.08	1.04	4.45	>.001
Match Problems	7.95	2.64	12.79	4.05	+ 4.82	.51	.78	.26	.61	.52	.46	.68	7.08	>.001
Hidden Figures	20.30	4.88	24.74	3.21	+ 4.45	.94	.62	.88	.38	.59	.58	.76	5.85	>.001
Gestalt Transformations	9.89	2.68	12.26	2.40	+ 2.37	.52	.46	.27	.21	.69	.15	.39	6.08	>.001
Myers-Briggs Extrovert	36.89	5.35	34.23	5.26	- 2.66	1.03	1.01	1.06	1.02	.44	1.16	1.08	2.46	>.01
Myers-Briggs Introvert	56.74	4.82	57.07	4.71	+ .33	.93	.91	.87	.83	.55	.77	.88	.38	NS
Myers-Briggs Sensation	45.48	5.72	45.33	4.09	- .15	1.10	.79	1.21	.62	.47	1.02	1.01	.15	NS
Myers-Briggs Intuitive	62.11	4.92	63.81	3.20	+ 1.70	.95	.62	.90	.38	.42	.79	.89	1.91	>.05
Myers-Briggs Thinking	41.70	6.31	41.19	4.73	- .52	1.21	.91	1.46	.83	.59	.99	1.00	.52	NS
Myers-Briggs Feeling	60.33	4.32	61.63	3.84	+ 1.30	.83	.74	.69	.55	.36	.79	.89	1.46	NS
Myers-Briggs Judgment	41.70	7.52	44.04	3.99	+ 2.33	1.45	.77	2.10	.59	.40	1.80	1.34	1.74	>.05
Myers-Briggs Perceptual	62.59	4.77	64.30	9.71	+ 1.70	.92	1.87	.85	3.50	-.03	4.62	2.15	.79	NS
TBR Motor Cognitive	109.85	12.85	111.11	21.87	+ 1.26	2.47	4.21	6.10	17.72	.01	23.61	4.86	.26	NS
TBR Persn. Percept.	108.41	26.72	109.44	13.52	+ 1.04	5.14	2.60	26.42	6.76	.12	29.98	5.47	.19	NS
TBR Psycho-Motor Speed	112.19	12.88	106.93	11.64	- 5.26	2.48	2.24	6.15	5.02	.67	3.73	1.93	2.72	>.01

Pre = Pre test; Post = post test; M = mean for group; σ = standard deviation; Mean Diff. = Mean Post - Mean Pre; SE Pre = $\frac{SD}{N}$(standard error of the mean); SE^2 = standard error squared; pp = correlation coefficient of Pre and Post Tests scores; $SE_D = SE_{Pre} + SE_{Post} - 2\,SE_{Pre}\,SE_{Post}$; $t = \frac{\text{Mean Diff.}}{SE_{Diff.}}$

Table (4) Control Pre Test and Post Test Results (N = 32)

	Pre M	Pre 6	Post M	Post 6	Mean Diff	SE Pre	SE Post	SE^2 Pre	SE^2 Post	pp	SE_D	SE_D	t	P level
Associational Fluency	16.63	5.58	19.19	6.01	+ 2.56	.98	1.05	.96	1.10	.61	.80	.89	2.88	<.01
Expressional Fluency	7.66	3.45	9.13	3.97	+ 1.47	.60	.70	.36	.49	.55	.39	.62	2.37	<.02
Ideational Fluency	64.91	12.36	63.91	17.31	- 1.00	2.17	3.04	4.71	9.24	.44	8.15	2.85	.35	NS
Word Fluency	44.41	11.59	46.63	11.31	+ 2.22	2.03	1.93	4.12	3.92	.45	4.42	2.10	1.06	NS
Alternate Uses	23.78	7.31	27.75	7.19	+ 3.97	1.28	1.26	1.64	1.59	.64	1.16	1.08	3.68	<.001
Camouflaged Words	6.94	2.05	10.50	2.91	+ 3.56	.36	.51	.13	.26	.29	.28	.53	6.71	<.001
Consequences Remote	12.97	7.70	10.78	7.16	- 2.19	1.35	1.26	1.82	1.59	.07	3.17	1.78	1.23	NS
Consequences Obvious	45.34	15.18	37.94	14.09	- 7.40	2.66	2.47	7.08	6.10	.69	4.12	2.03	3.65	<.001
Plot Titles High	.88	.94	1.28	1.25	+ .40	.16	.22	.03	.05	.28	.06	.24	1.67	NS
Plot Titles Low	10.78	4.58	14.84	6.74	+ 4.06	.80	1.18	.64	1.39	.61	.88	.94	4.32	<.001
Match Problems	9.84	3.87	12.34	4.32	+ 2.50	.68	.76	.46	.58	.63	.39	.62	4.03	<.001
Hidden Figures	20.38	4.95	25.69	2.98	+ 5.31	.87	.52	.76	.27	.12	.92	.96	5.53	<.001
Gestalt Transformations	9.81	3.25	12.31	2.66	+ 2.50	.57	.47	.32	.22	.58	.23	.48	5.20	<.001
Myers-Briggs Extrovert	38.66	5.28	35.31	5.07	- 3.35	.93	.89	.86	.79	.67	.91	.95	3.53	<.001
Myers-Briggs Introvert	59.22	5.05	58.41	4.77	- .81	.89	.84	.79	.71	.81	.82	.91	.89	NS
Myers-Briggs Sensation	42.59	4.25	42.22	5.05	- .37	.75	.89	.56	.79	.67	.59	.77	.48	NS
Myers-Briggs Intuitive	60.56	4.27	58.94	10.71	- 1.62	.75	1.88	.56	3.53	.24	.95	.93	1.65	<.10
Myers-Briggs Thinking	40.88	5.42	39.88	4.98	- 1.00	.95	.87	.90	.76	.66	.90	.95	1.05	NS
Myers-Briggs Feeling	61.13	5.31	59.09	11.59	- 2.04	.93	2.03	.87	4.12	.18	1.29	1.14	1.79	<.10
Myers-Briggs Judgment	40.41	5.02	41.53	5.28	+ 1.12	.88	.93	.77	.87	.70	1.22	1.11	1.00	NS
Myers-Briggs Perceptual	60.88	6.63	60.75	10.64	- .13	1.16	1.87	1.35	3.50	-.02	.19	.44	.30	NS
TBR Motor Cognitive	110.13	17.93	101.91	18.36	- 8.22	3.13	3.22	9.80	10.37	-.02	20.78	4.56	1.80	<.05
TBR Persn. Percept.	99.19	13.53	99.91	15.46	+ .72	2.37	2.71	5.62	7.34	.59	5.48	2.34	.31	NS
TBR Psycho-Motor Speed	85.75	11.07	106.00	14.40	+20.25	1.94	2.53	3.76	6.40	.82	2.14	1.46	13.87	<.001

Table (5) Tests for Significant Improvements of the Experimentals Over the Controls (Except TBR Psycho Motor Speed)

	$\bar{D}$	SE	t	p
Associational Fluency	+ 2.77	.89	3.11	< .001
Expressional Fluency	+ .56	.59	.94	NS
Ideational Fluency	+ 1.30	2.96	.44	NS
Word Fluency	+ 9.71	1.99	4.88	< .001
Alternate Uses	+ 5.77	1.12	5.15	< .001
Camouflaged Words	- .26	.56	.46	NS
Consequences Remote	+ 4.23	1.58	2.68	< .01
Consequences Obvious	+ 6.21	2.35	2.64	< .01
Plot Titles High	+ .56	.27	2.07	< .01
Plot Titles Low	+ .57	.99	.58	NS
Match Problems	+ 2.32	.65	3.57	< .001
Hidden Figures	- .87	.86	1.01	NS
Gestalt Transformations	- .13	.53	.25	NS
Myers-Briggs Extrovert	+ .69	1.03	.67	NS
Myers-Briggs Introvert	+ 1.14	.90	1.27	NS
Myers-Briggs Sensation	- 1.12	.90	1.24	NS
Myers-Briggs Intuitive	+ 3.32	.94	3.53	< .001
Myers-Briggs Thinking	+ .48	.96	.50	NS
Myers-Briggs Feeling	+ 3.34	.99	3.37	< .001
Myers-Briggs Judgment	- 1.21	1.23	.98	NS
Myers-Briggs Perceptual	+ 1.83	.59	3.10	< .001
TBR Motor Cognitive	+ 9.48	4.71	2.01	< .05
TBR Personality Perceptual	+ .31	4.03	.07	NS
TBR Psycho-Motor Speed	+25.51	1.69	15.10	< .001*

$\bar{D}$ = mean difference of controls - mean difference of experimentals
SE = standard error
t = "t" value
p = significance level
* = controls over experimentals

BIBLIOGRAPHY

1. Donald W. MacKinnon. The Institute of Personality Assessment and Research: "The Creative Person." Berkeley: University Extension, University of California, 1961.
2. J. P. Guilford. "Traits of Creativity," Creativity and Its Cultivation, ed. Harold H. Anderson. New York: Harper & Bros., 1959. pp. 142-161.
3. Warner K. Schaie. "A Test of Behavioral Rigidity," Journal of Abnormal and Social Psychology. LI 1955. pp. 439-448.
4. Ibid., Guilford.
5. Ibid., Schaie.
6. Kurt Koffka. Principles of Gestalt Psychology. New York: Harcourt, Brace & World, 1926.
7. Fred Attneave. "Some Informational Aspects of Visual Perception," Psychological Review. LXI 1954. pp. 183-193.
8. J. P. Guilford. P. R. Merrifield. Anna B. Cox. Reports from the Psychological Laboratory: "Creative Thinking in Children at the Junior High School Levels." Los Angeles: The University of Southern California, Sept. 1961. pp. 8-9.
9. Isabel Briggs Myers. The Myers-Briggs Type Indicator, 1962 Manual. Princeton: Educational Testing Service. pp. 19-20.
10. Op. Cit., Guilford. 1961. pp. 8-9.
11. Loc. Cit.
12. Quinn McNemar. Psychological Statistics. New York: John Wiley, 3rd ed., 1962. pp.110, 112.
13. Op. Cit., McNemar. p. 252.
14. Op. Cit., Myers. pp. 17-18, 9.
15. Op. Cit., Guilford. p. 9.
16. Ibid..p. 19.
17. Ibid. p. 18.
18. Ibid. p. 22.
19. Ibid. p. 21.
20. Op. Cit., Myers. pp. 1-2.
21. Ibid. pp. 58-59.
22. Op. Cit., MacKinnon. pp. VI-V24.
23. Ibid. pp. V13-V14.
24. Op. Cit., Myers. p. 16.
25. Ibid. p. 14.
26. Ibid. p. 16.
27. Warner K. Schaie. Test of Behavioral Rigidity: Preliminary Manual. Palo Alto: Consulting Psychologists Press, Inc. p. 9.
28. Loc. Cit. 29. Loc. Cit.